Delayed referral reduces the success of video-assisted thoracoscopic debridement for post-pneumonic empyema

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Abstract The aim of this study was to evaluate the effect of preoperative delay on the efficacy of video-assisted thoracoscopic surgery (VATS) for post-pneumonic pleural empyema (PPE). This was a prospective study of 39 consecutive patients with PPE who were treated by VATS with curative intent over a 4-year period. Failure to obtain full lung re-expansion resulted in conversion to thoracotomy. Pre- and post-operative variables were correlated with surgical outcome. VATS debridement was successful in 16 (41%) patients while conversion to open decortication was needed in 23 patients (21 immediate, two delayed). There was no difference in the age/sex distribution of the two groups. In the failed VATS group the delay from hospital admission to operation was longer: 24 (2·1) *vs.* 16·6 (2·7) days ($P = 0{\cdot}03$, 95% CI 0·53–14·3 days); operating time was longer: 128·2 (7·9) *vs.* 86·2 (10·4) min ($P = 0{\cdot}003$, 95% CI 15·2 – 68·5 min) and post-operative stay was longer: 8·4(0·8) *vs.* 5·2(0·6) days ($P = 0{\cdot}03$, 95% CI 1·1–5·3 days). VATS can be used successfully to treat PPE with a faster post-operative recovery when successful than open surgery. Delayed surgical intervention decreases the success of VATS thus earlier referral for surgical intervention in PPE (ideally within 21 days) is advocated to gain its full benefits.

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INTRODUCTION

Video-assisted thoracoscopic surgery (VATS) has been shown to have a therapeutic role in the management of pleural empyema (1,2). Debridement of the pleural space has been effected with complete clinical resolution. However, the optimum timing of VATS in the natural history of pleural sepsis remains undetermined. VATS is most likely to be successful in the fibrinopurulent phase of pleural empyema when the collection is multi-loculated but the pleural surfaces are not thickened. Once an organized visceral pleural cortex has developed, visceral pleural decortication via thoracotomy is required to achieve re-expansion of the underlying lung.

Several non-invasive therapeutic manoeuvres may be attempted in the early phases of pleural sepsis including pleural aspiration and tube drainage (3). Fibrinolytic therapy via an intercostal drainage tube has also been proposed as a method of pleural debridement (4). There are, therefore, many potential sources of delay to surgical intervention.

The aims of this study were to assess the effectiveness of VATs debridement in the treatment of post-pneumonic pleural empyema (PPE) and to assess whether VATS can be used irrespective of the duration of illness.

METHODS

Patient selection

Patients were referred to the Regional Thoracic Surgical Units at Glenfield Hospital, Leicester and Birmingham Heartlands Hospital from admitting pulmonologists. All patients had developed a parapneumonic pleural effusion with evidence of a multi-loculated pleural collection on preoperative chest radiography, ultrasound or computed tomography. Patients who had clear evidence of a thickened visceral pleural cortex on preoperative investigations were not considered for VATS and underwent primary thoracotomy and decortication. Exclusion criteria also included iatrogenic or post-traumatic empyema and any evidence of underlying thoracic malignancy. Thirty-

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nine consecutive patients with post-pneumonic pleural empyema were treated with curative intent by VATS.

Surgical methods

Video-assisted thoracoscopy was performed under general anaesthesia, double-lumen intubation and single lung ventilation. Initial port placement was determined by preoperative scans and placed towards the apex of the pleural collection. Video-assisted examination of the cavity was performed via this incision and facilitated by blunt dissection via a second more inferior incision. Having broken down loculations (Fig. 1) the pleural debris was removed from the cavity by a novel modification in which a 36 Fr chest drain was connected directly to high suction and directed by an attached Roberts artery forceps inserted by a small incision 1 cm from the tip of the drain (Fig. 2). Complete debridement usually required a third 2 cm incision placed posteriorly with rotation of the position of

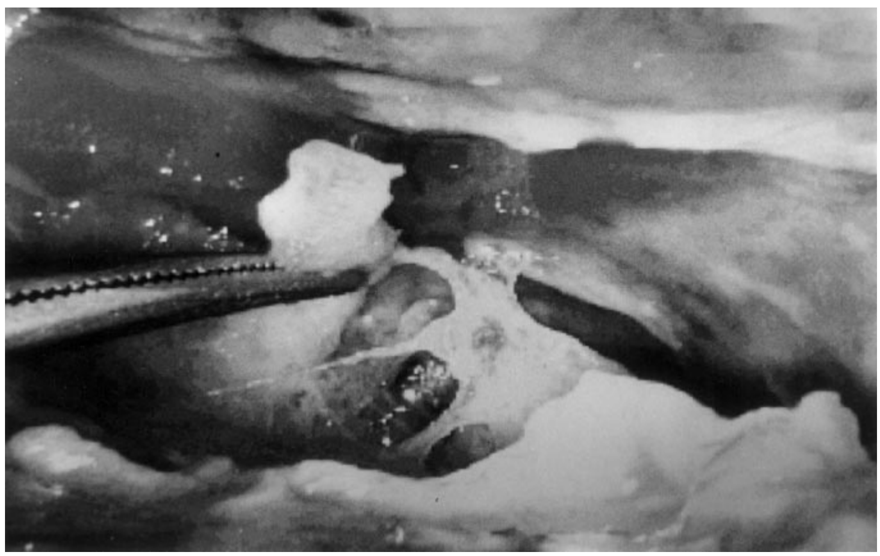

Fig. 1. Mechanical breakdown of multiple loculations in post-pneumonic pleural empyema.

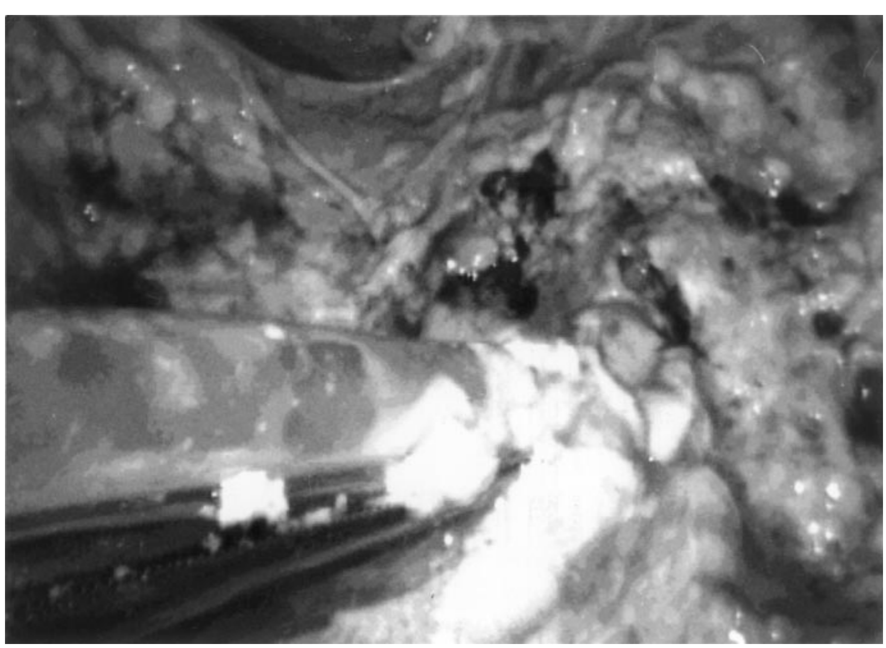

Fig. 2. Mechanical debridement of pleural empyema using a directed suction device.

Table 1. Results summary

Mean (SE)	VATS success (group V)	VATS failures (group T)
Number	16	23
Age (years)	44·4 (20·7)	44·5 (21·1)
Male:female	8:8	17:6
Pre-operative delay (days)	16·6 (2·7)	24·0 (2·1)
Operating time (min)	86·2 (10·4)	128·2 (7·9)
Post-operative stay (days)	5·2 (0·6)	8·4 (0·8)
Hospital mortality	0	1

camera and suction. Pleural lavage with 0·9% saline was then performed and the lung was inflated under vision.

If apposition of visceral and parietal pleural surfaces could not be obtained when positive pressure ventilation (up to 40 cm H_2O) was applied to the underlying lung then decortication via a posterolateral thoracotomy was carried out immediately under the same anaesthetic. Two pleural 28 Fr drains (basal and apical) were placed after either VATS or thoracotomy and connected to suction at 40 mmHg.

Data Collection

Preoperative details were recorded of the delay between hospital admission and referral for sugery, and the delay between referral and operation. Intra-operative pleural cultures were sent and operating time was recorded. Post-operatively, the duration of chest drainage and post-operative hospital stay were recorded. Patients were followed during outpatient clinic attendance for at least the first 6 months after surgery.

Statistical analysis

Results were expressed as mean (SE). Data was analysed using the SPSS statistical package. Differences in continuous clinical variables between treatment groups were analysed using unpaired *t*-tests and for categorical variables by Chi-square analysis. *P*-values $<0{\cdot}05$ were taken to demonstrate statistically significant differences.

RESULTS

Of the 39 patients who were treated with curative intent by VATS, 18 patients had initial completed debridement. In the remaining 21 patients VATS was aborted intra-operatively due to a thickened visceral cortex preventing lung expansion. In these patients an immediate thoracotomy was performed and decortication achieved. Two patients initially treated by VATS subsequently required thoracotomy and decortication at 1 and 2 days respectively when full lung re-expansion had not been obtained despite intercostal tube suction. Thus, of the original 39 patients, 16 patients (41%) were deemed to have had successful VATS treatment (group V) while 23 patients were deemed to be VATS failures (group T).

There was no difference in the age/sex distribution of the two groups (Table 1). Group V consisted of eight males and eight females, aged 44·4 (20·7) years. Group T contained 17 males and six females, aged 44·5 (21·1) years.

Perioperative course (Table 1)

The time interval between initial hospital admission and surgery in group A was significantly shorter in group V than in group T: 16·6 (2·7) days *vs*. 23·9 (2·3) days ($P=0{\cdot}04$, 95% CI 0·19–14·5 days) but there was no significant difference in the delay from surgical referral to operation in the two groups.

Operating time was significantly shorter for VATS debridement than thoracotomy and decortication: 86·2 (10·4) min *vs*. 128·2 (7·9) min ($P=0{\cdot}003$, 95% CI 15·2–68·5 min). Patients in whom VATS was successful had their chest drains removed earlier and were discharged significantly earlier than those who required thoracotomy: 5·2 (0·6) days *vs*. 8·7 (0·9) days, ($P=0{\cdot}02$, 95% CI 1·3–5·6 days). There was only one death within 30 days of operation due to myocardial infarction which occurred in group T. There have been no reoperations for recurrent pleural sepsis in the group V.

Microbiology (Table 2)

A significantly higher proportion of patients in group T than group V had sterile pleural cultures at the time of

Table 2. Microbiology of operative pleural cultures

Organism	Group V (successful)	Group T (failed)
No growth	6	19
Staphylococcus aureus	4	1
Pseudomonas aeruginosa	3	0
Streptococus pneumoniae	2	2
Klebsiella	1	1

operation: 19 patients (83%) *vs*. six patients (38%), $P < 0{\cdot}05$, Chi-square.

DISCUSSION

The clinical management of pleural sepsis requires an understanding of the evolution of a complex empyema and a working method of classisfication. Light has proposed a classification based on the quantity and characteristics of the pleural fluid and the presence or absence of pleural loculations (5). In this system surgical intervention should be considered once a complex parapneumonic effusion has developed characterized by multiple loculi but before the onset of frank pus. Once a simple empyema has formed, at 4–6 weeks into the illness (6), there is a likelihood of visceral pleural thickening and VATS is unlikely to be successful.

Failure to obtain parenchymal re-expansion has been the reason for conversion to open thoracotomy in this series. The conversion rate in other series varies from 10% (7) to 28% (8) and reflects similar problems with advanced disease at the time of surgery. It must be acknowledged however that, as in other series, the operating surgeon was not blinded to the preoperative details, introducing a possible bias in that the knowledge of a longer preoperative delay may have made the surgeon more ready to convert to open surgery.

The differences between successful and failed VATS illustrate the importance of earlier referral for surgery. The higher incidence of sterile pleural cultures in the VATS failures is a reflection of the longer duration of antibiotic therapy and prolonged preoperative course. This study did not include post-operative, post-traumatic or malignant empyemas where earlier diagnosis may be expected in patients under closer medical supervision.

The delay in surgical intervention was quantified by the period of in-hospital treatment rather than the preoperative duration of illness as this was felt to be a more accurate measure. It was also used to emphasize the important role of pulmonologists in determining the eventual outcome of this disease.

The longer operating time in the failed VATS group is obviously due to the time taken to open and close the thoracotomy and no further analysis is valid. Other authors have however also noted the faster perioperative course from VATS compared to thoracotomy (9). However, although the study was not randomized, there was a significantly longer post-operative stay in the failed VATS group which is attributable to a longer period of mobilization required after thoracotomy.

Our finding that delay in the timing of surgery is important contradicts that of Lawrence *et al*. (10), who found there was no significant difference in the preoperative delay of patients who were either successfully or unsucessfully treated by VATS. It is possible that the patients in our series were operated upon earlier in the time-course of the empyema than those in Lawrence's series. This may be reflected in the higher proportion of positive pleural cultures at surgery in our series.

We believe that one procedure is better than two and therefore advocate that the decision to convert to open decortication should be taken at the initial operation. We do not share the view that VATS may be used to stabilize the patient's condition prior to formal thoracotomy as this exposes the patient to the combined risks of two periods of general anaesthesia.

Although not specifically identified in our series, the recent increased interest in pleural fibrinolysis presents a potential reason for delayed referral. Intra-pleural streptokinase has been shown to improve the drainage of infected material in loculated parapneumonic effusions (4) although it has not been shown to reduce morbidity or mortality (11). However, in a randomized trial, VATS was found to have higher efficacy, shorter hospital stay and lower cost than catheter-directed fibrinolytic therapy (12). Thus for patients with large loculated empyemas the inappropriate use of intra-pleural streptokinase may only postpone surgery and importantly, this delay may result in VATS no longer being successful. However, the optimal management plan may include a carefully observed period of fibrinolysis limited to 72 h to be followed immediately by VATS debridement. Indeed, this protocol has been shown to result in shorter hospital stay and reduced mortality (13).

Unless there is clear radiological evidence of a thickened visceral cortex VATS may be used to assess all multiloculated pleural empyemas and in the majority of cases debridement will be successful. Greater awareness of this therapeutic modality should promote earlier imaging of parapneumonic effusions. Earlier identification of pleural loculation should then promote earlier discussion with the Thoracic Surgeon of the appropriateness of fibrinolysis or surgical intervention. As we have found with surgical intervention for spontaneous pneumothorax (14), if the full potential of VATS is to be realized it must be considered earlier in the management protocol. Although this proposition is widely held by thoracic surgeons we feel this supporting evidence is important. The end result of this protocol should be a reduction in the thoracotomy rate for empyema and a reduction in overall hospitalization.

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